

**OZONE MAPPING PROFILING SUITE (OMPS)**

Sensor Requirements Document (SRD)

for

**NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL  
SATELLITE SYSTEM (NPOESS) SPACECRAFT AND SENSORS**

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## **1. SCOPE**

### **1.1 IDENTIFICATION**

This Sensor Requirements Document sets forth the requirements for the Ozone Mapping and Profiler Suite (OMPS) of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and is hereinafter referred to as the Sensor Suite.

### **1.2 SENSOR SUITE OVERVIEW**

The purpose of the OMPS is to collect specialized data to permit the calculation of the vertical and horizontal distribution of Ozone in the earth's atmosphere. These data are processed and delivered to the users in the form of Raw Data Records (RDRs), Sensor Data Records (SDRs), and Environmental Data Records (EDRs).

The OMPS shall consist of one or more optical system(s) that can monitor the ozone component of the upper atmosphere by making radiative measurements in bands corresponding to ozone absorption and emission. The OMPS will be capable of making measurements as required to meet the Ozone Profile Environmental Data Record requirements for NPOESS.

One OMPS flight unit shall be provided to meet an early flight opportunity on the POES N' satellite to be available for launch in 2004 (TBR). Three flight units shall be provided for the NPOESS 1330 nodal crossing time C1, C3, and C5 which will be available for launch in 2007, 2010, and 2016. The purpose of the early flight opportunity on POES N' is to meet user requirements in advance of the first NPOESS launch.

There are several accommodation constraints that will be placed on the OMPS which may have an effect on satisfaction of ozone EDRs. The sensor suite contractors are encouraged to provide detailed accommodation/performance trade data to the IPO. It is the IPO's intent for the sensor suite contractors to study designs that fall within or very close to the accommodation constraints. Designs that offer increased performance at a substantial increase in accommodation parameters are discouraged, as they will not be strong candidates for NPOESS.

### **1.3 DOCUMENT OVERVIEW**

This document contains all performance requirements for the sensor suite. This document also defines all sensor-spacecraft interfaces for the sensor suite. The contractor should use the document as the basis of a proposed sensor suite specification. The documentation listed in section 2.0 follows an approach of minimum specs and standards. The contractor may add to or revise the documents listed in section 2.0 in coordination with the government. The term "(TBD)" applied to a missing requirement means that the contractor should determine the missing requirement in coordination with the government. The term "(TBS)" means that the government will supply the missing information in the course of the contract. The term "(TBR)" means that the requirement is subject to review for appropriateness by the contractor or the government. The government may change "(TBR)" requirements in the course of the contract.

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Appendix A contains a definition of the terms used throughout the document. Appendix B, NPOESS survivability requirements, is classified and, if applicable, will be made available after contract award. Appendix C is a Sensor Data Record Characteristics section presently TBR. Appendix E contains the RDRs and EDRs required for each Central and Field Terminal (TBR). Appendix F defines the acronyms and abbreviations used throughout the document. Appendix G describes Potential Pre-planned Product Improvements (P<sup>3</sup>I). Appendix H is the Verification Cross Reference Matrix (TBD). The TRD Appendix D contains the NPOESS EDR requirements.

### 1.3.1 CONFLICTS

#### SRDX1.3.1-1

In the event of conflict between the referenced documents and the contents of this specification, the contents of this specification shall be the superseding requirements.

#### SRDX1.3.1-2

In the event of a conflict involving the external interface requirements, or in the event of any other unresolved conflict, the contracting officer shall determine the order of precedence.

### 1.3.2 REQUIREMENT WEIGHTING FACTORS

The requirements stated in this specification are not of equal importance or weight. The following three paragraphs define the weighting factors incorporated in this specification.

- a. **Shall** designates the most important weighting level; that is, mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the contracting officer.
- b. **Should** designates requirements requested by the government and are not mandatory. Unless required by other contract provisions, noncompliance with the *should* requirements does not require approval of the contracting officer.
- c. **Will** designates the lowest weighting level. These *will* requirements designate the intent of the government and are often stated as examples of acceptable designs, items, and practices. Unless required by other contract provisions, noncompliance with the *will* requirements does not require approval of the contracting officer and does not require documented technical substantiation.

### 1.4 SYSTEM CLASSIFICATIONS N/A

## 2. APPLICABLE DOCUMENTS

### 2.1 GOVERNMENT DOCUMENTS

The following documents, of the exact issue shown, form a part of this SRD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, see Section 1.3.1. Tailoring of documents in this section is (TBR).

#### **SPECIFICATIONS:**

##### Military

DOD-E-83578A May 96	General Specification for Explosive Ordnance for Space Vehicles
Mil-A-83577B Feb 88	Moving Mechanical Assemblies for Space Launch Vehicles
MIL-C-24308 Apr 97	General Specification for Connectors, Electric, Rectangular, Non-Environmental, Miniature, Polarized Shell, Rack, and Panel
MIL-C-38999 Dec 97	Connectors, Receptacle, Electrical, Circular, Breakaway Wall Mounting Flange, Removable Crimp Contacts, Sockets, Series III, Shell Size 25, Metric

#### **STANDARDS:**

##### Federal

FED-STD-209E Sep 92	Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones
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##### Military

MIL-STD-461D Jan 93	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462D Jan 93	Measurement of Electromagnetic Interference Characteristics
MIL-STD-975 Aug 94	NASA Standard Electrical, Electronic, and Electro-mechanical (EEE) Parts List, Revision M, 5 May 1998
MIL-STD-1540C Sep 94	Test Requirements for Launch, Upper Stage, and Space Vehicles

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MIL-STD-1541A Electromagnetic Compatibility Requirements for Space  
Dec 87 Systems

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MIL-STD-1553B      Digital Time Division Command/Response Multiplex Data  
Jan 96                      Bus

Department of Commerce/NOAA None (TBR)

**OTHER PUBLICATIONS:**

Regulations

AFM 91-201              Explosive Safety Standards  
7 Oct 94

EWR 127-1              Eastern and Western Range Safety Requirements  
31 Mar 95

Handbooks None (TBR)

Bulletins None (TBR)

Other

GPS ICD 200 REV      “NAVSTAR GPS Space Segment/Navigation User  
C, 19 January 1995      Interface”(U)

GPS ICD 203, REV      “NAVSTAR GPS SA/AS Requirements (S)  
B 22 Dec 1993

(Contractors requiring copies of specifications, standards, handbooks, drawings, and publications in connection with specified acquisition functions should obtain them from the contracting activity or as directed by the contracting officer.)

**2.2 NONGOVERNMENT DOCUMENTS**

The following documents, of the exact issue shown, form a part of this SRD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, see Section 1.3.1.

**SPECIFICATIONS:** None (TBR)

**STANDARDS:**

CCSDS 203.0-B-1      CCSDS Recommendations for Space Data System  
Jan 87                      Standards. Telecommand, Part 3: Data Management  
Service, Architectural Definition, Issue 1

CCSDS 701.0-B-2      CCSDS Recommendations for Advanced Orbiting  
Dec 87                      Systems, Networks and Data Links, Architectural  
Specification

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ISO/TC 209                      Cleanrooms and Associated Controlled Environments  
(ISO/DIS 14644-1)  
Jan 97

National                              Hazardous Materials Management Program  
Aerospace  
Standard (NAS)  
411  
Rev 2, 29 Apr 94

SAE AS1773                      Fiber Optics Mechanization of an Aircraft Internal Time  
May 88                              Division Command/Response Multiplex Data Bus

**DRAWINGS:** None (TBR)

**OTHER PUBLICATIONS:** None (TBR)

### **2.3 REFERENCE DOCUMENTS**

The following documents are for reference only and do not form a part of this specification. They are listed here because various parts of the SRD refer to them.

#### **SPECIFICATIONS:**

Military None (TBR)

#### **STANDARDS:**

ANSI/ISO 9899                      Programming Language--C  
1990

DOD 5200.28-                      Department of Defense Trusted Computer System  
STD                                      Evaluation Criteria  
Mar 88

EIA/IEEE J-STD                      Standard for Information Technology, Software Life  
016 30 Sep 95                      Cycle Processes, Software Development, Acquirer-  
Supplier Agreement

MIL-STD-129M                      Marking for Shipment and Storage Notice 1, 15 Sep 89  
1 Jun 93

MIL-STD-882c                      System Safety Program Requirements  
Jan 93

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MIL-STD 961D Aug 95	DoD Standard Practice for Defense Specifications, w/ Notice 1
MIL-STD-1246C Apr 94	Military Standard Product Cleanliness Levels and Contamination Control Program
MIL-STD-1522A May 84	Standard General requirements for Safe Design and Operation of Pressurized Missile and Space Systems Notice 2: 20 Nov 86; Notice 3: 4 Sep 92
MIL-STD-1542B Nov 91	Electromagnetic Compatibility (EMC) and Grounding Requirements for Space Systems Facilities
MIL-STD-1543B Oct 88	Reliability Program Requirements for Space and Launch Vehicles
MIL-STD-1547A Dec 92	Parts and Materials Program for Space and Launch Vehicles
MIL-STD-1809 Feb 91	(USAF) Space Environments for USAF Space Vehicles
MIL-STD-1815A	ADA Programming Language
TM-86-01	Technical Manual Contract Requirements

Department of Commerce

DOC Sep 95 Edition Sep 95	National Telecommunications and Information Administration, Manual of Regulations for Federal Radio Frequency Management
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NOAA

S24.801 Nov 72	Preparation of Operations and Maintenance Manuals, Revised Apr 97
S24.806 Jan 86	Software Development, Maintenance, and User Documentation, Revised Apr 94
S24.809 Dec 89	Grounding Standards

NASA

PPL-21	Preferred Parts List, Goddard Space Flight Center
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SP-R-0 022A (JSC) 9 Sep 74	General Specification, Vacuum Stability Requirements of Polymeric Material for Spacecraft Application
NASA Tech Memo 100471	Orbital Debris Environments for Spacecraft Designed to Operate in Low Earth Orbit
SP 8031 1969	NASA Space Vehicle Design Criteria/Structures

**OTHER PUBLICATIONS:**

Regulations None (TBR)

Handbooks

DOD-HDBK- 263B (date)	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies, Equipment
MIL-HDBK-340 1 Jul 85	Application Guidelines for MIL-STD-1540B
DOD-W-83575 Jun 96	Gen Spec for Wiring Harness, Space Vehicle, Design and Testing
MIL-I-46058  1985	Insulating Compound. Electrical (for Coating Printed Circuit Assemblies)  Handbook of Geophysics and Space Environments
AFM 15-111 1 Sep 96	Surface Weather Observations

Bulletins None

Other

TRD for NPOESS (current version)	Technical Requirements Document (TRD) for National Polar- Orbiting Operational Environmental Satellite System (NPOESS) Spacecraft Payloads
IRD for NPOESS (current version)	Interface Requirements Document (IRD) for National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Spacecraft

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IORD for NPOESS 28 Mar 96	Integrated Operational Requirements Document (IORD) for National Polar Orbiting Operational Environmental Satellite System (NPOESS) Spacecraft Payloads
ASTME-595-93 (current version)	Standard Test method for Total Mass Loss and Collected Volatile Condensable Materials for Outgassing in a Vacuum Environment
Attachment C S- 480-80 Revised December 1994	AMSU-A Instrument Performance and Operation Specification (for the EOS/METSAT Integrated Programs); NASA GSFC
SYS/AMS/J0105/ BAE 03 Feb 1993	AMSU-B Instrument System Specification (British Aerospace)

(Technical society and technical association specifications and standards are generally available from reference libraries. They are also available in technical groups and using federal agencies. Contact the contracting officer regarding any referenced document not readily available from other sources.)

### **3. SENSOR SUITE REQUIREMENTS**

#### **3.1 DEFINITION**

##### **3.1.1 OMPS DESCRIPTION**

###### **SRDO3.1.1-1**

The OMPS shall consist of one or more instruments designed to measure scene radiance in a number of spectral bands due to Ozone.

###### **SRDO3.1.1-2**

The contractor shall determine the number of spectral bands and the spectral band limits, as well as the performance requirements associated with these bands, in order to satisfy Environmental Data Record (EDR) requirements.

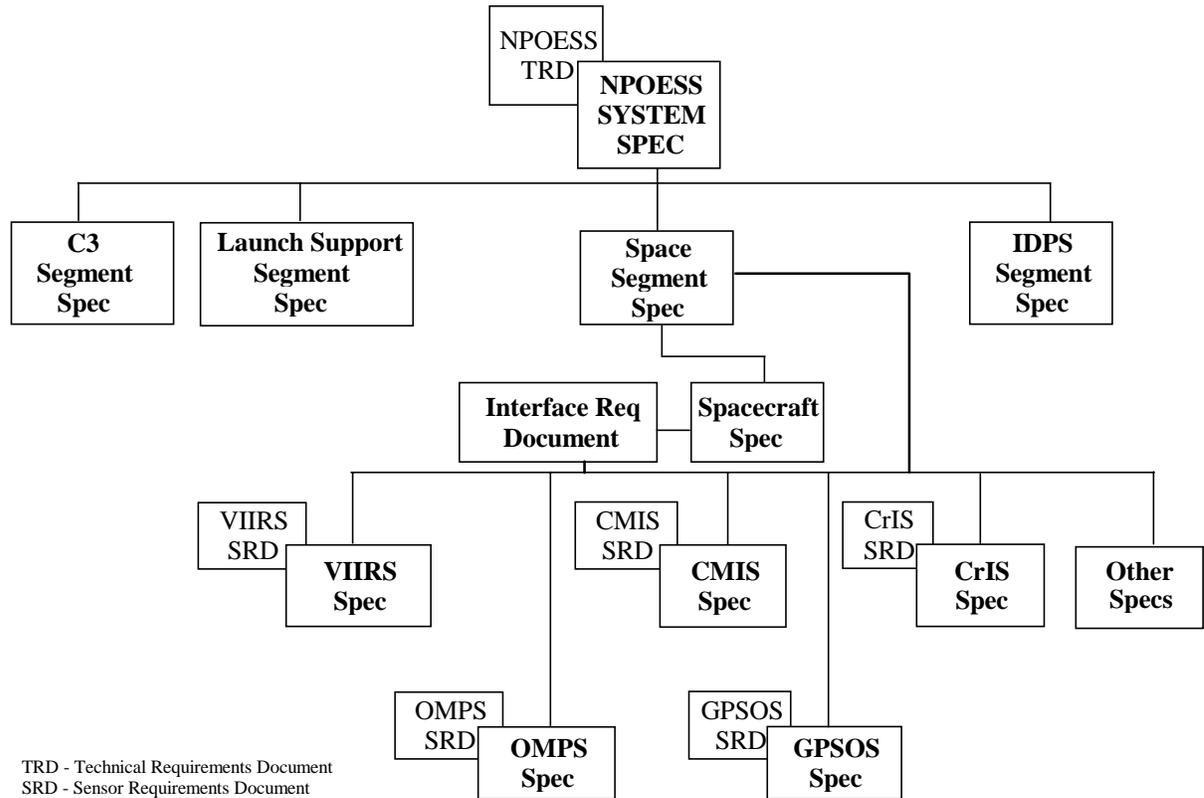
###### **SRDO3.1.1-3**

The contractor shall determine sensor suite architecture (that is the number of instruments and modules comprising the sensor suite) in order to maximize performance while minimizing overall size, weight and power requirements. The Government desires to provide early NPOESS data to users by possibly flying one or more of the OMPS sensors, (e.g., an ozone mapper instrument) on POES. This will be considered in making the sensor suite architecture decision.

###### **SRDO3.1.1-4**

The contractor shall choose the scan mechanism used by the OMPS. On-orbit calibration is required in all spectral bands. In addition, a means for on-orbit monitoring of the quality of the on-orbit calibration and any temporal changes in instrument response should be provided.

### 3.1.2 SPECIFICATION TREE



**Figure 3.1.2 Partial Specification Tree for the NPOESS System.**

### 3.1.3 TOP-LEVEL OMPS FUNCTIONS

SRDO3.1.3-1

The OMPS instrument shall perform the following functions:

- scene radiance measurement
- on-orbit calibration
- on-orbit monitoring of calibration sources and instrument response changes
- acquisition of sensor suite health and status data
- generation of data streams containing scene radiance, calibration, monitoring, health and status data
- reception of command and control data

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### **3.1.4 OMPS MODES**

#### **SRDO3.1.4-1**

The sensor suite (instruments) shall implement the following modes as a minimum:

- OFF Mode
- OPERATIONAL Mode
- DIAGNOSTIC Mode
- SAFE HOLD Mode

### **3.1.5 COMMON SENSOR MODES**

#### **3.1.5.1 Sensor Off Mode**

In the Sensor Off mode, no power is supplied to the Sensor.

#### **3.1.5.2 Operational Mode**

##### **SRDO3.1.5.2-1**

The sensor shall be in full functional configuration during this mode.

##### **SRDO3.1.5.2-2**

Mission and housekeeping data shall be collected.

##### **SRDO3.1.5.2-3**

Calibrations shall be done during regular operations.

#### **3.1.5.3 Sensor Diagnostic Mode**

##### **SRDO3.1.5.3-1**

Diagnostic mode shall include trouble shooting and software updates.

#### **3.1.5.4 Sensor Safe Hold Mode**

In the Safe Hold mode, health and status data are collected and transmitted. Mission and calibration data are not collected. In Safe Hold mode, most components are turned off, with survival heaters activated.

##### **SRDO3.1.5.4-1**

The Safe Hold Mode is a power conservation mode. The Sensor shall accept a command in the event the spacecraft enters an anomalous configuration or orientation as determined by the spacecraft computer. A power subsystem anomaly is such an event.

##### **SRDO3.1.5.4-2**

The C&DH shall issue power conservation re-configuration commands to the sensors via the data bus that will place the sensor in a safe configuration. The return to the Normal Operations Mode requires ground intervention.

### **3.1.6 SENSOR SPECIFIC MODES**

TBD

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### **3.1.7 SENSOR SUITE MODE DOCUMENTATION**

#### SRDO3.1.7-1

The OMPS ICD shall define sensor suite (instrument) modes.

#### SRDO3.1.7-2

The OMPS ICD shall define Safe Hold Mode re-configuration commands.

### **3.1.8 OPERATIONAL AND ORGANIZATIONAL CONCEPT**

#### **3.1.8.1 Launch Operations Concept**

##### 3.1.8.1.1 Pre Launch

The satellite will be transported directly to the launch base where final vehicle preparations and checkout will be accomplished. Final inter-segment and launch system verification tests will be accomplished prior to launch.

##### 3.1.8.1.2 Launch and Injection

During launch and injection to the operational orbit, the sensor suite may be powered on or turned off in order to provide protection from the launch and injection environments or to comply with other specified requirements. After insertion into its operational orbit and separation from the launch vehicle, appropriate deployments would be initiated by memory command. Spacecraft telemetry to monitor vehicle status will be provided during launch and injection. Transmission of launch vehicle telemetry may satisfy this requirement during the launch phase. Spacecraft telemetry transmission to ground monitoring stations would be used to the extent practicable during the injection phase. Early orbit check-out will be conducted at the NPOESS primary SOC in Suitland, MD.

#### **3.1.8.2 On-orbit Operational Concept**

The NPOESS satellite will operate in a near circular, sun-synchronous orbit. The nominal orbit for the satellite is 833 km altitude, 98.7 degree inclination. The orbit will be a "precise" orbit (i.e., altitude maintained to  $\pm 17$  (TBR) km,  $\pm 0.05$  (TBR) degrees inclination, nodal crossing times maintained to  $\pm 10$  minutes throughout the mission lifetime) to minimize orbital drift (precession). NPOESS must be capable of flying at any equatorial node crossing time. However, the nominal configuration is with the satellite orbits equally spaced, with 0530 and 1330 nodal crossing times for the U.S. Government spacecraft and 2130 for the METOP satellite. The OMPS will fly only on the "mid-day" NPOESS satellite.

#### SRDO3.1.8.2-1

The OMPS instrument design shall be such that data acquisition and necessary calibrations can be completed if the satellite is flown with an equatorial crossing time (ascending or descending) between 09:30 (TBR) and 14:30 (TBR). Selection of a specific orbital time of day, for NPOESS satellites, will be made sixty (60) days before launch.

#### SRDO3.1.8.2-2

Specified EDR performance shall be obtained for any of the orbits in SRDO3.1.8.2-1, except for the restrictions in SRDO3.1.8.2-3.

#### SRDO3.1.8.2-3

The satellite shall only be flown in orbits that keep sunlight off of the cold side of the spacecraft. Because of natural variations in the orbit, the 10 minute nodal crossing time constraint, and variations in the solar illumination of the satellite, this will restrict the spacecraft from flying in orbits within about 30 (TBR on satellite contractor) minutes of noon.

##### 3.1.8.2.1 On-orbit Tests

The initial on-orbit period is devoted to a complete spacecraft checkout and the calibration and performance verifications of the payload. The spacecraft and payload performance verification tests may be repeated at appropriate times during the operational phase of the mission.

##### 3.1.8.2.2 On-orbit Operations

###### SRDO3.1.8.2.2-1

The sensor suite shall be capable of operating for up to 21 days (with a goal of 60 days) without additional commands.

### **3.1.9 MISSIONS**

The mission of the OMPS is to collect specialized data to permit the calculation of the vertical and horizontal distribution of Ozone in the earth's atmosphere.

## **3.2 SENSOR SUITE CHARACTERISTICS**

### **3.2.1 PERFORMANCE CHARACTERISTICS**

The performance characteristics of the OMPS are driven by the data product requirements of the EDR supported by the OMPS: Ozone Column and/or Profile.

#### SRDO3.2.1-1

Instrument level requirements shall be derived by the contractor based on a flowdown of EDR requirements to instrument performance requirements using the contractor's EDR algorithms

### **3.2.1.1 Performance Requirements**

Performance requirements in the OPERATIONAL MODE are provided below.

#### SRDO3.2.1.1-1

The contractor shall recommend performance requirements for the other modes, if needed.

#### 3.2.1.1.1 EDR Requirements

##### SRDO3.2.1.1.1-1

The OMPS design and algorithms shall be adequate to allow satisfaction of the environmental data records listed in Section 3.2.1.1.1.1.

##### SRDO3.2.1.1.1-2

As a minimum, this EDR shall be satisfied at the threshold level.

##### SRDO3.2.1.1.1-3

The modifications and clarifications of EDR requirements in this section shall take precedence over any conflicting requirements or statements in Appendix D of the TRD and the IORD.

##### SRDO3.2.1.1.1-4

If a derived requirement conflicts with an explicit requirement and/or another derived requirement, the most stringent requirement shall be satisfied. For any attribute where a percentage and a numerical value are specified, the greater of the two is the requirement.

#### 3.2.1.1.1.1 Ozone Mapping and Profile EDR Requirements

The EDR requirement thresholds listed below must be met when data from the OMPS is processed using appropriate algorithms.

The ozone retrieval algorithm may include requirements for input data from other NPOESS sensor suites, including the CrIMSS temperature and moisture sounders, the CMIS conical microwave imager, and the VIIRS visible imager. Sensor suite Performance Requirements for these other sensor suites are provided in the CrIMSS, VIIRS, and CMIS SRD specifications. In addition, the contractor should identify all ancillary data sources needed to meet the threshold requirements.

### **Ozone Total Column/Profile (DOC)**

Ozone total column is defined as the amount of ozone in a vertical column of the atmosphere measured in Dobson Units (milli-atm-cm). Ozone vertical profile is defined as the volumetric concentration of ozone in specified segments of a vertical column of the atmosphere measured in parts per million volume (ppmv). For this EDR, vertical cell size is the vertical height of the column segment and the vertical reporting interval specifies the locations of the column segment bottoms for which ozone parameters must be reported. Total Column requirements listed below apply under all cloud conditions. Profile threshold requirements apply down to the level of the tropopause.

Units:

Total column: milli-atm-cm

Profile: ppmv

Para. No.		Thresholds	Objectives
	a. Horizontal Cell Size		
SRDO3.2.1.1.1.1-1	1. Total Column	50 km @ nadir	50 km
SRDO3.2.1.1.1.1-2	2. Profile	250 km	250 km
SRDO3.2.1.1.1.1-3	b. Horizontal Reporting Interval	(TBD)	(TBD)
	c. Vertical Cell Size		
SRDO3.2.1.1.1.1-4	1. Total Column	60 km	60 km
SRDO3.2.1.1.1.1-5	2. Profile, 0 - Tropopause	N/A	3 km
SRDO3.2.1.1.1.1-6	3. Profile, Tropopause - 25 km	5 km	1 km
SRDO3.2.1.1.1.1-7	4. Profile, 25 - 60 km	5 km	3 km
	d. Vertical Reporting Interval		
SRDO3.2.1.1.1.1-8	1. Total Column	N/A	N/A
SRDO3.2.1.1.1.1-9	2. Profile	Vertical Cell Size	Vertical Cell Size
SRDO3.2.1.1.1.1-10	e. Horizontal Coverage	Solar zenith angles < 80 degrees	Global
SRDO3.2.1.1.1.1-11	f. Vertical Coverage		
SRDO3.2.1.1.1.1-11a	1. Total Column	0 - 60 km	0 - 60 km
SRDO3.2.1.1.1.1-11b	2. Profile	Tropopause - 60 km	0 - 60 km
	g. Measurement Range		
SRDO3.2.1.1.1.1-12	1. Total Column	50 - 650 milli-atm-cm	50 - 650 milli-atm-cm
SRDO3.2.1.1.1.1-13	2. Profile, 0 - Tropopause	N/A	0.01 - 3 ppmv
SRDO3.2.1.1.1.1-14	3. Profile, Tropopause - 60 km	0.1 - 15 ppmv	0.1 - 15 ppmv
	h. Measurement Accuracy		
SRDO3.2.1.1.1.1-15	1. Total Column	15 milli-atm-cm	5 milli-atm-cm
SRDO3.2.1.1.1.1-16	2. Profile, 0 - Tropopause	N/A	10 %
SRDO3.2.1.1.1.1-17	3. Profile, Tropopause - 15 km	Greater of 20 % or 0.1 ppmv	10 %
SRDO3.2.1.1.1.1-	4. Profile, 15 - 60 km	Greater of 10	5 %

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Para. No.		Thresholds	Objectives
18		% or 0.1 ppmv	
	i. Measurement Precision		
SRDO3.2.1.1.1.1-19	1. Total Column	3 milli-atm-cm + 0.5 % of measured ozone	1 milli-atm-cm
SRDO3.2.1.1.1.1-20	2. Profile, 0 - Tropopause	N/A	10 %
SRDO3.2.1.1.1.1-21	3. Profile, Tropopause - 15 km	10 %	3 %
SRDO3.2.1.1.1.1-22	4. Profile, 15 - 50 km	3 %	1 %
SRDO3.2.1.1.1.1-23	5. Profile, 50 - 60 km	10 %	3 %
	j. Long Term Stability		
SRDO3.2.1.1.1.1-24	1. Total Column	1 %	0.5 %
SRDO3.2.1.1.1.1-25	2. Profile	2 %	1 %
	k. Mapping Uncertainty		
SRDO3.2.1.1.1.1-26	1. Total Column, at nadir	5 km	5 km
SRDO3.2.1.1.1.1-27	2. Profile	25 km	25 km

	l. Maximum Local Average Revisit Time		
SRDO3.2.1.1.1.1-28	1. Total Column	24 hrs	24 hrs
SRDO3.2.1.1.1.1-29	2. Profile	7 days	24 hrs
	m. Maximum Local Refresh		
SRDO3.2.1.1.1.1-30	1. Total Column	N/A	N/A
SRDO3.2.1.1.1.1-31	2. Profile	N/A	N/A

SDRO3.2.1.1.1.1-32

The contractor shall specify the conditions under which the requirement to deliver the EDR meeting data content and quality requirements will not be met, regardless of whether it is clear or cloudy.

SRDO3.2.1.1.1.1-33

The contractor shall also specify the conditions under which it would recommend delivering an EDR which is incomplete and/or of degraded quality but which is still of potential utility to one or more users.

SRDO3.2.1.1.1.1-34

If data from another non-OMPS sensor are required to meet a threshold for any of these EDRs, the OMPS contractor shall identify the data content, quality, and timeliness required from the other sensor. The government may impose modified requirements on the OMPS if:

- a) It becomes evident that data having the required content, quality, and timeliness will not be available from the other sensor, or
- b) If the OMPS does not provide data having the content, quality, and timeliness required by another sensor to meet the other sensor's primary EDR requirements.

Any requirement modifications will be at the government's discretion, following technical interchange and coordination with the affected contractors. These modified requirements may be imposed on the OMPS, the other sensor, or both. The other sensor need not be one addressed in this procurement.

A primary EDR is defined as an EDR for which a sensor contractor has been assigned primary sensor and algorithm development responsibility. The algorithm may or may not require the use of additional data from other than the primary sensor.

3.2.1.1.2 SDR Requirements (TBR)

In processing RDRs into EDRs, the IDPS will generate intermediate-level satellite instrument data files, including Sensor Data Records (SDRs). SDRs are needed for retrospective processing, leading to improved methods, and for archival, for long-term sensor evaluation or troubleshooting. SDRs will be delivered to the same user destinations as the associated EDRs, as specified in the EDR/RDR matrix (Appendix E),

which lists delivery destinations of RDRs/EDRs. The generation and delivery of operational SDRs will be the responsibility of the IDPS (TSPR) contractor, not the OMPS contractor. See Appendix A for the definition of SDR.

#### 3.2.1.1.2.1 SDR Content (TBR)

At a minimum, operational SDRs will include the following information:

- SDR identification tag
- Spacecraft identification tag
- Orbit Number
- Sensor identification tag
- Flight software version number
- Data Mode (TBR)
- Data acquisition orbit number
- Data transmission orbit number
- Spacecraft Orientation
- Beginning Julian date and time tag
- Ending Julian date and time tag
- Ascending Node Julian date and time tag
- Identification of RDRs, databases, algorithms, and other ancillary data used to generate the SDR
- Channel Identification
- Calibrated in-band earth radiance per sample
- Calibration source radiance data
- Calibration hardware instrumentation data
- Identification of type and time of calibration data acquisition for all calibrations utilized
- Earth location (latitude/longitude) information
- Solar Elevation angle (nadir)
- Lunar Phase angle (nadir)
- Lunar Elevation angle (nadir)
- Scan or stare index
- Beginning and end times of scan or stare
- Data sufficient to allow calculation of time tag for each sample to the nearest millisecond
- Internal sensor temperatures, voltages, and currents

The IDPS (TSPR) contractor, not the OMPS contractor, will be responsible for defining the content of operational SDRs.

The OMPS contractor may recommend the content of operational SDRs. The government, at its discretion, may provide this recommendation to the IDPS (TSPR) contractor.

#### SRDO3.2.1.1.2.1-1

The OMPS contractor shall participate in technical interchange meetings with the IDPS (TSPR) contractor to support the definition of the operational SDRs with respect to both content and format, if so requested by the government.

The OMPS contractor will determine the content of SDRs generated by the contractor for requirements validation purposes.

#### 3.2.1.1.2.2 SDR Format

The IDPS (TSPR) contractor, not the OMPS contractor, will be responsible for defining the format of operational SDRs.

The OMPS contractor may recommend the format of operational SDRs. The government, at its discretion, may provide this recommendation to the IDPS (TSPR) contractor.

The OMPS contractor will determine the format of SDRs generated by the contractor for requirements validation purposes.

#### 3.2.1.1.3 RDR Requirements (TBR)

Since RDRs are processed into EDRs, RDRs are considered to have met their requirements when they are of an appropriate format and quality to be adequately processed into their associated EDRs. See Appendix A for the definition of RDR.

#### SRDO3.2.1.1.3-1

The OMPS contractor shall be responsible for generating operational RDRs.

#### 3.2.1.1.3.1 RDR Content (TBR)

##### SRDO3.2.1.1.3.1-1

At a minimum, operational RDRs shall include the following data:

- Channel identification
- Compression information (if used)
- Uncalibrated earth scene radiometric data (compressed or raw)
- Calibration source raw radiometric data
- Calibration hardware instrumentation data
- Identification of type and time of calibration data acquisition for all calibrations utilized
- Sensor related data necessary for geolocation of samples
- Scan or stare index
- Beginning and end times of scan or stare
- Data sufficient to allow calculation of time tag for each sample

#### SRDO3.2.1.1.3.1-2

The following data, at a minimum, shall be appended to or incorporated in an operational RDR at least every five minutes:

- RDR identification tag
- Spacecraft identification tag
- Sensor identification tag
- Flight software version number
- Spacecraft related data necessary for geolocation
- Data mode (TBR)
- Data acquisition orbit number
- Data transmission orbit number
- Critical sensor temperatures, voltages, and currents
- Ascending Node Julian date and time tag

#### 3.2.1.1.3.2 RDR Format (TBR)

##### SRDO3.2.1.1.3.2-1

The contractor shall determine the RDR format for each mode within the packet envelopes.

#### 3.2.1.1.4 Earth Location Requirements

##### SRDO3.2.1.1.4-1

The OMPS shall be designed so that with scientific geolocation algorithms (adopted, adapted, or developed by the contractor), the mapping uncertainty requirements of all primary EDRs will be met. Spacecraft and spacecraft/sensor interface characteristics which contribute to geolocation errors are specified in Section 3.2.4.2.1.3.

##### SRDO3.2.1.1.4-2

The contractor shall define sensor requirements necessary to meet the mapping uncertainty requirements of the primary EDRs.

#### 3.2.1.1.5 Algorithms (TBR)

##### 3.2.1.1.5.1 Scope

##### SRDO3.2.1.1.5.1-1

The contractor shall adopt or adapt existing algorithms or develop new scientific algorithms for all primary EDRs. (See Section 3.2.1.1.1.1.) Adopting an algorithm means using an existing algorithm without change. Adapting an algorithm means using an existing algorithm with some modification, such as different values of coefficients, inclusion of higher order corrections, fusion of additional data sources, etc.

#### SRDO3.2.1.1.5.1-2

The contractor shall also adopt or adapt existing algorithms or develop new scientific algorithms for all intermediate level data products used to generate the primary EDRs, such as SDRs and flags indicating data quality, daytime versus nighttime, clear versus cloudy, etc. Since the OMPS contractor is not responsible for the content or format of operational SDRs, the OMPS contractor may select the appropriate intermediate-level data products needed as inputs to his scientific EDR algorithms in satisfying this requirement. The description of operational SDRs in Section 3.2.1.1.2 is provided as guidance. Algorithms need not be provided for data products that are generated by other sensor suites and utilized as inputs to the algorithms for OMPS primary EDRs.

#### SRDO3.2.1.1.5.1-3

The Contractor shall provide an Algorithm Theoretical Basis Document (ATBD) for the assigned set of Primary EDRs. ATBDs provide the physical theory and assumptions behind the EDRs, as well as the mathematical procedures required to produce the RDRs, convert the RDRs into the SDRs, and convert the SDRs into the EDRs. The ATBD should discuss limitations on the approach, accuracy considerations, additional information required for measurement processing (mandatory and desirable), and alternative processing approaches required under alternative measurement situations (e.g., daytime and nighttime observations).

#### SRDO3.2.1.1.5.1-4

The Contractor shall provide research grade source code implementing the algorithm(s) described in the ATBD that address the primary EDRs. The research grade code should include all processes, other than input/output, needed to: convert RDRs into SDRs; convert SDRs into EDRs; use all mandatory outside data; use any optional outside data, if available; select alternative processing algorithms based on the data available; provide continuing calibration validation; and any other similar processing tasks required to satisfy allocated EDR quality and availability requirements. The scientific algorithms provided by the contractor may be adopted or adapted from existing algorithms, or developed, as needed.

### 3.2.1.1.5.2 Performance Requirements

#### SRDO3.2.1.1.5.2-1

The performance of the scientific EDR algorithms delivered by the OMPS contractor shall meet EDR thresholds and shall be no worse than the performance of algorithms utilized for current (TBR) operational data products for these EDRs, if such operational products exist.

#### 3.2.1.1.5.3 Operational Algorithm Teams (OATs)

The government's Operational Algorithm Teams (OATs) may recommend scientific algorithms. These teams have contributed to the definition of the instrument requirements of Section 3. The OATs may also provide advisory information on OMPS functional and calibration requirements.

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#### 3.2.1.1.5.4 Convertibility to Operational Code

The government considers the EDR algorithms adopted, adapted, or developed by the OMPS contractor to be scientific, rather than operational, algorithms. The OMPS contractor is not responsible for the conversion of scientific algorithms into operational EDR algorithms for the OMPS. (Any operational algorithms necessary for the generation of RDRs will ultimately be the responsibility of the OMPS contractor, and the operational code implementing these algorithms will be part of the required flight software. This statement applies to the post-downselect phase of the OMPS program.)

##### SRDO3.2.1.1.5.4-1

The scientific EDR algorithms delivered by the OMPS contractor shall be convertible into operational code that is compatible with a 20 minute maximum processing time at either the DoD Centrals or DoD field terminals for the conversion of all pertinent RDRs into all required EDRs for the site or terminal, including those based wholly or in part on data from other sensor suites. The intent of this requirement is to preclude algorithms that are so computationally intensive that any foreseeable implementation would stress or exceed the time available for delivery of EDRs in an operational environment.

##### SRDO3.2.1.1.5.4-2

The means by which the contractor shall validate the requirement that scientific algorithms be convertible to operational code subject to the constraint specified in SRDO3.2.1.1.5.4-1 is TBR.

##### SRDO3.2.1.1.5.4-3

The availability of any inputs required from databases or other ancillary sources to generate data products shall also be adequate to allow EDRs to be generated at the DoD Centrals and DoD field terminals within the time constraint specified in SRDO3.2.1.1.5.4-1.

#### 3.2.1.1.5.5 Multiple Sensor Requirements

##### SRDO3.2.1.1.5.5-1

The contractor shall identify any constraints on the relationships between sensors within OMPS (if OMPS is comprised of more than one sensor) or between sensors in different sensor suites that are entailed by the contractor's algorithms for the OMPS primary EDRs which require data from multiple sensors. Such constraints might include, for example, relative pointing knowledge, relative pointing accuracy, co-boresighting, synchronization, etc. Based on this information and the corresponding information from other sensor contractors, the government may impose modified or additional requirements on the OMPS and/or other sensor suites. (See Sec. 3.2.1.1.5.6)

#### 3.2.1.1.5.6 Sensor Suite Capability Relationships

Constraints on relationships between different sensor suites or different sensors within the OMPS suite entailed by the primary OMPS EDR algorithms are included in this section.

##### 3.2.1.1.5.6.1 Reference Timelines (TBS)

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3.2.1.1.5.6.2 Relationships between Sensors in Different Sensor Suites (TBR)

3.2.1.1.5.6.2.1 Relative Pointing Knowledge (TBR)

3.2.1.1.5.6.2.2 Relative Pointing Accuracy (TBR)

3.2.1.1.5.6.2.3 Co-Boresighting (TBR)

3.2.1.1.5.6.2.4 Synchronization (TBR)

3.2.1.1.5.6.3 Relationships between Sensors within a Suite (TBD)

### **3.2.1.2 Sensor Suite Calibration**

SRDO3.2.1.2-1

The sensor suite shall perform periodic autonomous or ground controlled mission sensor suite calibration as required.

3.2.1.2.1 Type of Calibration (TBD)

SRDO3.2.1.2.1-1

Calibration shall include all radiometric calibration, wavelength calibration, and detector electronics gain/offset calibration required to meet the EDR requirements.

SRDO3.2.1.2.1-2

Complete and comprehensive preflight radiometric calibration shall be provided.

3.2.1.2.2 Frequency of Calibration (TBD)

3.2.1.2.3 Calibration Source Requirements (Emissivities, Temperatures, etc.) (TBD)

3.2.1.2.4 Calibration Source Monitoring Requirements (TBD)

SRDO3.2.1.2.4-1

The sensor suite shall provide for monitoring changes in the relative spectral reflectivity of any solar calibration mechanism over the spectral range of the measurements.

3.2.1.2.5 Sensor Suite Electronic Response Monitoring Requirements (TBD)

SRDO3.2.1.2.5-1

The OMPS shall provide for in-flight measurement of changes in gain and offset of the detector(s) and associated electronics.

### 3.2.1.3 Data Formatting and Compression

SRDO3.2.1.3-1

The data packets generated by the OMPS shall conform to the Consultative Committee for Space Data Systems (CCSDS) packetization per the (TBS) real-time interface specification and the (TBS) stored-data interface specifications.

### 3.2.1.4 Dynamic Range (TBD)

### 3.2.1.5 Linearity (TBD)

### 3.2.1.6 Quantization (TBD)

### 3.2.1.7 Sensitivity (TBD)

### 3.2.1.8 Spatial Resolution (Bounds on MTF at specified spatial frequencies) (TBD)

### 3.2.1.9 Horizontal Sampling Interval (TBD)

### 3.2.1.10 Standard Earth Scenes

The NPOESS IPO will provide sounder data sets in each of 16 categories/areas, for use in evaluating sensor suite designs, and in verifying sensor suite and algorithm performance. The government will create an additional set of sounder data sets in each area/category which will be used by the government to develop an independent assessment of sensor suite design performance and algorithm performance. Ozone and temperature datasets will consist of at least the following three components:

1) Individual, high resolution profiles to give latitude & seasonal coverage will be in the following locations and combined with SAGE II Profiles (\*POAM at the South Pole). Data files have O3 mixing ratios, number densities, pressure, temperature, and optical depth for 1 km layers, surface to 70 km.

<u>Balloonsondes</u>	<u>Lat</u>	<u>Lon</u>
ALERT	82	-62
RESOLUTE	75	-85
GOOSE	53	-60
HOHEN	48	11
SAPPORO	43	141
BOULDER	40	-105
WALLOPS	38	-75
NAHA	26	129
HILO	20	-155
NATAL	-6	-35
SAMOA	-14	-170
TAHITI	-18	-149

LAVERTON	-38	145
MARAMBIO	-64	-57
SYOWA	-69	40
SOUTH POLE	-90	-25*

- 2) Ozone field from two adjacent orbits from SBUV/2.
- 3) Standard Profiles and perturbation analysis.

**3.2.1.11 Absolute Radiometric Accuracy and Stability (TBD)**

3.2.1.11.1 Absolute Accuracy (TBD)

3.2.1.11.2 Short-term Stability (TBD)

3.2.1.11.3 Long-term Stability (TBR)

SRDO3.2.1.11.3-1

The long-term stability requirement shall apply over the 7 year operational design life of the OMPS instrument.

3.2.1.11.4 Interchannel Accuracy (TBD)

**3.2.1.12 Field-of-View Alignment (TBD)**

3.2.1.12.1 Maximum Misalignment between Instrument Reference and Spacecraft Reference Axes (TBD)

3.2.1.12.2 Pointing Knowledge (TBD)

3.2.1.12.3 Co-registration of Data Channels (TBD)

3.2.1.12.4 Maximum Allowed Alignment Change (During ground test, launch, or on orbit) (TBD)

**3.2.1.13 Minimum Number of Channels or Bands (TBD)**

**3.2.1.14 Center Frequency or Wavelength (TBD)**

**3.2.1.15 Bandpass Limits** (N % response frequencies, where N = 50, 10, 1, etc.) **(TBD)**

**3.2.1.16 Polarization (TBD)**

3.2.1.16.1 Polarization Purity (TBD)

3.2.1.16.2 Insensitivity to Polarization (TBD)

**3.2.1.17 Channel Isolation** (Bound on response in one channel due to signal in another channel) **(TBD)**

**3.2.1.18 Out-of-Band Rejection** (Bound on response in a channel due to integrated out-of-band signal) **(TBD)**

**3.2.1.19 Instantaneous Field of View (IFOV) (TBD)**

3.2.1.19.1 Response Uniformity (Intra-IFOV) (TBD)

3.2.1.19.2 Out-of-Field Response (Bound on integrated response outside the IFOV) (TBD)

3.2.1.19.3 Shape (TBD)

**3.2.1.20 Intra-band Response Uniformity (TBD)**

3.2.1.20.1 Temporal (TBD)

3.2.1.20.2 Spatial (TBD)

**3.2.1.21 Stray Light Rejection (TBD)**

**3.2.2 NPOESS SPECTRUM UTILIZATION**

The NPOESS Integrated Program Office (IPO) is bound by the terms of the International Telecommunication Union (ITU) and National Telecommunication Information Agency (NTIA) for all RF spectrum utilization by all NPOESS subsystems: communications, active sensors, and passive sensors. For passive sensor spectrum utilization, the ITU has allocated spectrum dedicated and shared Earth Environmental Sensor Systems (EESS). ITU EESS allocations are listed in the “Manual of Regulations and Procedures for Federal Radio Frequency Management, September 1995 Edition.” There are passive

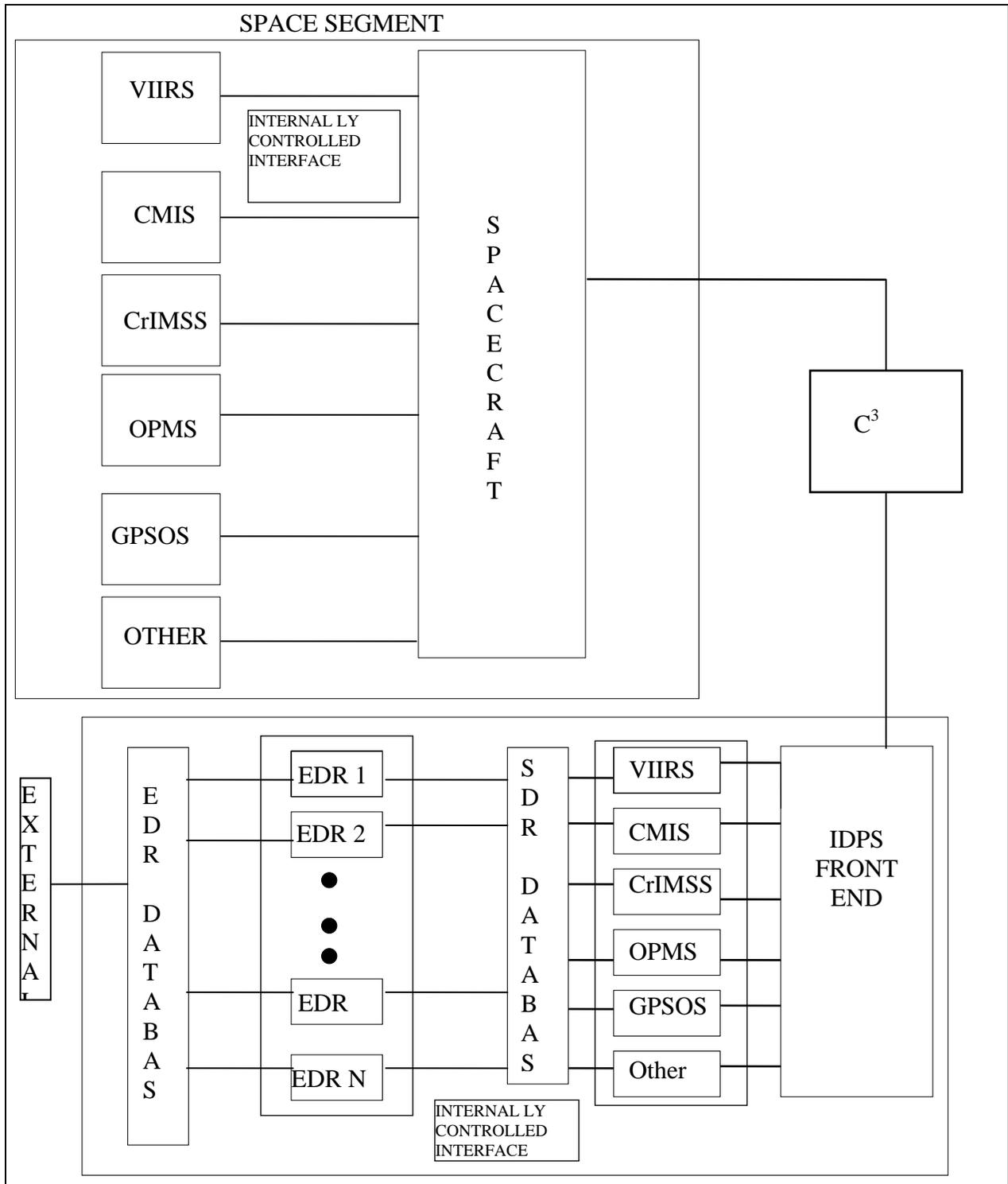
microwave sensors operating in space today without spectrum protection. The NPOESS IPO is formally bound to the spectrum utilization processes, as instituted by the NTIA and the ITU. Therefore, the IPO has limited ability to influence the ITU's allocations for EESS. The following requirement is only applicable should the OMPS contractor decide to use a passive microwave system in order to satisfy ozone EDRs.

#### SRDO3.2.2-1

The Contractors working on the passive microwave instruments shall perform an iterative design as follows: a) design the instrument constrained by ITU dedicated, exclusive use EESS frequency allocations and identify those EDRs which cannot satisfied.; b) propose the use of non-ITU allocated bands that are currently on-orbit to satisfy the instrument EDRs. An instrument contractor's proposed use of these non-ITU allocated EESS bands hold significant risk to the NPOESS by potentially producing contaminated data. Use of risk mitigation techniques such as sub-band sampling and out of band checking for "ground truth" are strongly encouraged.

### **3.2.3 INTERFACE REQUIREMENTS**

The Sensor interfaces are depicted in Figure 3.2.3 below.



**Figure 3.2.3 Sensor Interfaces**

Interface requirements for POES are TBS.

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### 3.2.4 PHYSICAL AND INTERFACE CHARACTERISTICS

The mass, average power, volume, and data rate budgets for the OMPS are provided herein. These values are the maximum allowed and include margin. Contractors are advised that any relaxation from these stated values will only be considered if the changes are consistent with the NPOESS program requirements to accommodate the full NPOESS payload suite of instruments on a spacecraft which can be placed into a nominal 833 km orbit by an EELV-class launch vehicle. The spacecraft-to-sensor interface requirements are broken down into four primary groups: mechanical, power, data, and thermal. A notional diagram of the top-level functional interfaces for any sensor is shown in Figure 3.2.4. In addition, environmental, software, testing, contamination, launch environment, and safety requirements are defined.

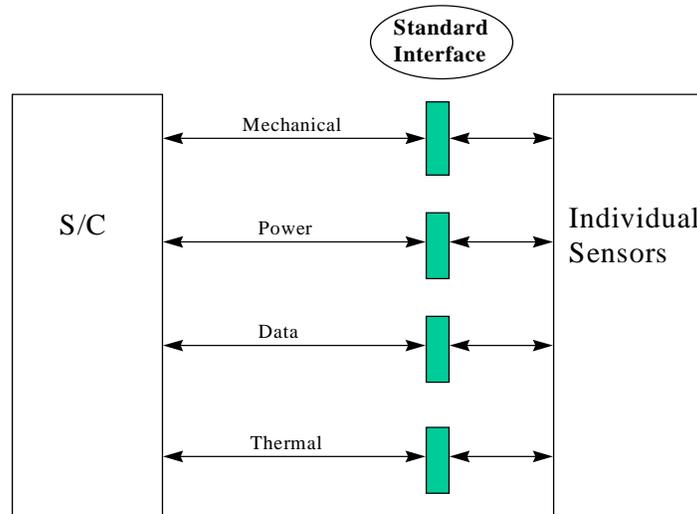


Figure 3.2.4. Notional Spacecraft-To-Sensor Functional Interfaces.

#### SRDO3.2.4-1

The mass of the OMPS shall be less than or equal to 45 kilograms.

#### SRDO3.2.4-2

The stowed dimensions of OMPS shall be less than or equal to the following limits:

- a) Velocity direction: 54 cm
- b) Nadir direction: 35 cm
- c) Anti-solar direction: 56 cm
- d) Components mounted internal to the spacecraft bus (TBR)

#### SRDO3.2.4-3

The average power consumption for OMPS shall be less than or equal to 45 Watts.

SRDO3.2.4-4

The data rate of the OMPS, at any moment in the orbit, shall be less than or equal to 40 kbps.

**See Common Section-Version 2**